Working Safely with Perchloric Acid

- All work with Perchloric Acid requires prior approval -

1. OVERVIEW

Perchloric acid is extremely hazardous, and every effort should be made to find safer alternatives. Perchloric acid is a strong inorganic acid that poses many hazards and can form explosive perchlorate crystals. Per WorkSafeBC regulations, a special wash-down fume hoods MUST be used (see section 5 below).

2. HAZARD

	Oxidizer (Cat 1) and may cause or intensify a fire when in contact with combustible materials and flammable liquids. Dry forms and concentrations over 85% can be explosive.
	Corrosive (Cat 1) to metals, and severely corrosive to skin and eyes. It is a very strong mineral acid.
	Specific target organ toxicity - repeated exposure (Category 2). May cause damage to organs (Thyroid) through prolonged or repeated exposure.

3. RESPONSIBILITY

Employer - All work must be pre-approved by the Principal Investigator (PI) prior to use. PIs are required to provide all PPE and safety training specific to each solution and method of use.

Employee - Must be aware of the hazards, know the details of this SWP and be fully trained and signed off in the proper use, disposal, and emergency procedures before starting work.

4. TRAINING REQUIRED

Training must include:

- Orientation to the location and use of the nearest eye wash, safety shower, and spill kit.
- Chemical Safety Course (offered by SRS)
- Reading and understanding the relevant Safety Data Sheets.
- Documented site-specific training and demonstrated competence on the techniques and processes to be used (i.e., safe work procedure - SWP), spill clean technique and emergency procedures.

A review of the SWP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

5. ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

A. Engineering/Ventilation Controls

Perchloric acid 70% conc and over and any concentration if solution is heated

1) All work with perchloric acid ≥70% or work involving heating of a perchloric acid solution (of any concentration) must be done in an annually certified, specially designated, wash-down fume hood.

Solvents or organic material must never be used or stored in a dedicated perchloric acid fume hood. The fume hood must be in the immediate vicinity of a safety shower and emergency eyewash station.

2) Verify the fume hood is "on" and the "wash-down" is working before using it and use the fume hood with the sash at the certified position or lower. No extraneous chemicals or materials should be present in the fume hood while performing the work.
3) The steps above include when diluting a ≥70% solution to lower concentrations.

Perchloric acid less than 70% conc **and** work done at or below room temperature

4) Work must be done in an annually certified fume hood. Solvents or organic material must never be used or stored in a fume hood at the same time work with perchloric acid is occurring. The fume hood must be in the immediate vicinity of a safety shower and emergency eyewash station.
5) Verify the fume hood is "on" and use the fume hood with the sash at the certified position or lower. No extraneous chemicals or materials should be present in the fume hood while performing the work.

B. Personal Protective Equipment (PPE) - Note that perchloric acid can contaminate PPE over time. Care should be taken when handling used PPE, and it should be treated as a hazardous material.

1) Eye Protection – At minimum, safety googles (not glasses) must be used. A combination of safety googles and face shield is recommended.
2) Skin & Body Protection - No exposed skin allowed. Wear lab coat, long pants, and closed-toe shoes. A chemical resistant Neoprene apron must be worn on top of the lab coat.
3) Hand Protection - Handle with gloves. Glove material depends on the type of contact (consult SDS). Two sets of chemical-resistant gloves (e.g., nitrile or neoprene) should be worn ("double-gloving"). A heavy-duty glove, such as butyl rubber, Viton, or equivalent, is recommended. Use gauntlet gloves if working with anhydrous perchloric acid.

C. Additional Information

- Ensure that all required materials are available in case of spill, emergency, and waste collection.

6. GUIDELINES FOR SAFE WORK PRACTICES

A. Storage

- Minimal quantities of material should be purchased and stored. Perchloric acid at concentrations above 85% should not be purchased or stored in any quantity.
- Perchloric acid is incompatible with strong bases, strong acids, amines, phosphorus halides, alcohols, organic materials, powdered metals, strong reducing agents (i.e., sulfuric acid), dimethyl sulfoxide. Perchloric acid should be stored in an acid cabinet with other inorganic acids, away from organic chemicals and reducers. Secondary containers should be used, made of glass, porcelain, ceramic, or other non-absorbing, non-combustible material. Do not store over extended periods of time.
- Date all opened perchloric acid containers. Inspect stock monthly and prolonged storage should be avoided. Do not store under the sink, in wooden cabinets or on paper-lined shelving.
- If a container of perchloric acid has turned dark and has crystals forming around the bottom, there is a potential explosion hazard. Do NOT move the bottle and contact SRS for immediate assistance.

B. Handling

- Substitute with less hazardous chemicals when possible. Use dilute solutions (< 60%) when possible.
- Never work alone with perchloric acid. A second person should be present and must be trained to emergency and spill clean procedures.

- Always transfer perchloric acid over a sink or other suitable containment in order to catch any spills and for ease of cleanup and disposal. Perform all work on chemically resistant surfaces.
- Change gloves often and use proper glove removal technique (without touching glove outside surface). Wash hands and forearms thoroughly with soap and water each time gloves are removed.
- Dilute only by adding perchloric acid slowly to water while stirring, never add water to perchloric acid. Never heat perchloric acid in an oil bath or with an open flame.
- Thoroughly rinse all surfaces and lab-ware after each use to remove any residues.

C. Waste

- Waste Perchloric Acid should be placed in a chemically compatible container and disposed of as hazardous waste. Do not mix waste with organic waste.
- Perchloric Acid contaminated material is hazardous waste and never disposed in the trash.

D. Emergency Procedures

A CAIRS (Centralized Accident / Incident Reporting System) report must be filed for any incident involving a perchloric acid spill or exposure (injury/near-miss).

1) Individual exposure
   - Immediately remove contaminated PPE items and/or contaminated clothing. Place contaminated items in a container with water.
   - If perchloric acid contacts skin and/or eye(s), flush contaminated area with water for at least 15 minutes. During this time call 24444 for first aid. SDS must be provided to the responders.
2) Large spills
   - **DO NOT ATTEMPT TO CLEAN UP** a spill volume larger than 100 ml of perchloric acid
   - Evacuate the lab and contact UBC campus security and/or 911 for assistance.
3) Small spills on equipment or surfaces can only cleaned if the correct equipment is present and the staff understands the hazards associated with perchloric acid.
   - Alert supervisor and personnel in the immediate area and ask a co-worker to bring the spill kit
   - Isolate spill area (caution tape, signage).
   - Put on PPE (face shield over safety googles, disposable gloves, neoprene gloves on top, PVC apron over lab coat, rubber boots – if necessary)
   - Neutralize by slowly pouring acid neutralizer (sodium carbonate, Spill X-A, Neutrasorb or equivalent product) from the perimeter of the spill, inward. The quantity of neutralizer will vary with the concentration of the acid.
   - NOTE: the spill should NOT be whipped up with organic or combustible materials (paper towels, rags, etc.) because perchloric acid is incompatible with these materials and when they dry, these materials can spontaneously ignite.
   - Use a plastic dustpan/brush to transfer the neutralized slurry to a container of water for disposal. Contact UBC ESF for info on disposal of the container and contents.
   - Wiping/rinsing down the area two times with soap & water solution is recommended.
4) Surfaces can also be tested to check for perchlorate contaminations:
   - *Diphenylamine Test:* Dissolve one gram of diphenylamine in 10 mL of “1 to 1” (18N) sulfuric acid to form a diphenylamine sulfate solution. Using a medicine dropper, apply this solution to the test

surface. The liquid turns black upon contact with perchlorate. The solution also reacts with nitrates but turns blue.

- *Methylene Blue Test:* Use 0.4% solution of methylene blue in water. Add a few drops of indicator solution to about 25 mL of trial solution, such as water used to test rinse from a length of potentially contaminated duct. Perchlorates will produce a violet precipitate.

7. DOCUMENT INFORMATION

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